



NREL National Renewable Energy Laboratory

Costa de Cocos 11 kW Wind-Diesel Hybrid System

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Hybrid Power Workshop

National Wind Technology Center





Background of Costa de Cocos Resort

- Small resort in Southern Mexico with existing diesel and small battery charging system
- Need for 24-hour power without running diesel
- Potential for diesel fuel savings by displacing fuel with wind energy
- Owner wanted to use reverse osmosis system for water desalination
- Idea of “green power” and ecotourism appealing; owner familiar with nearby Xcalak hybrid power system
- Cost shared funding available





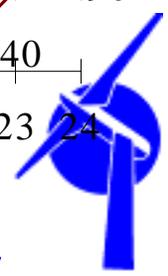
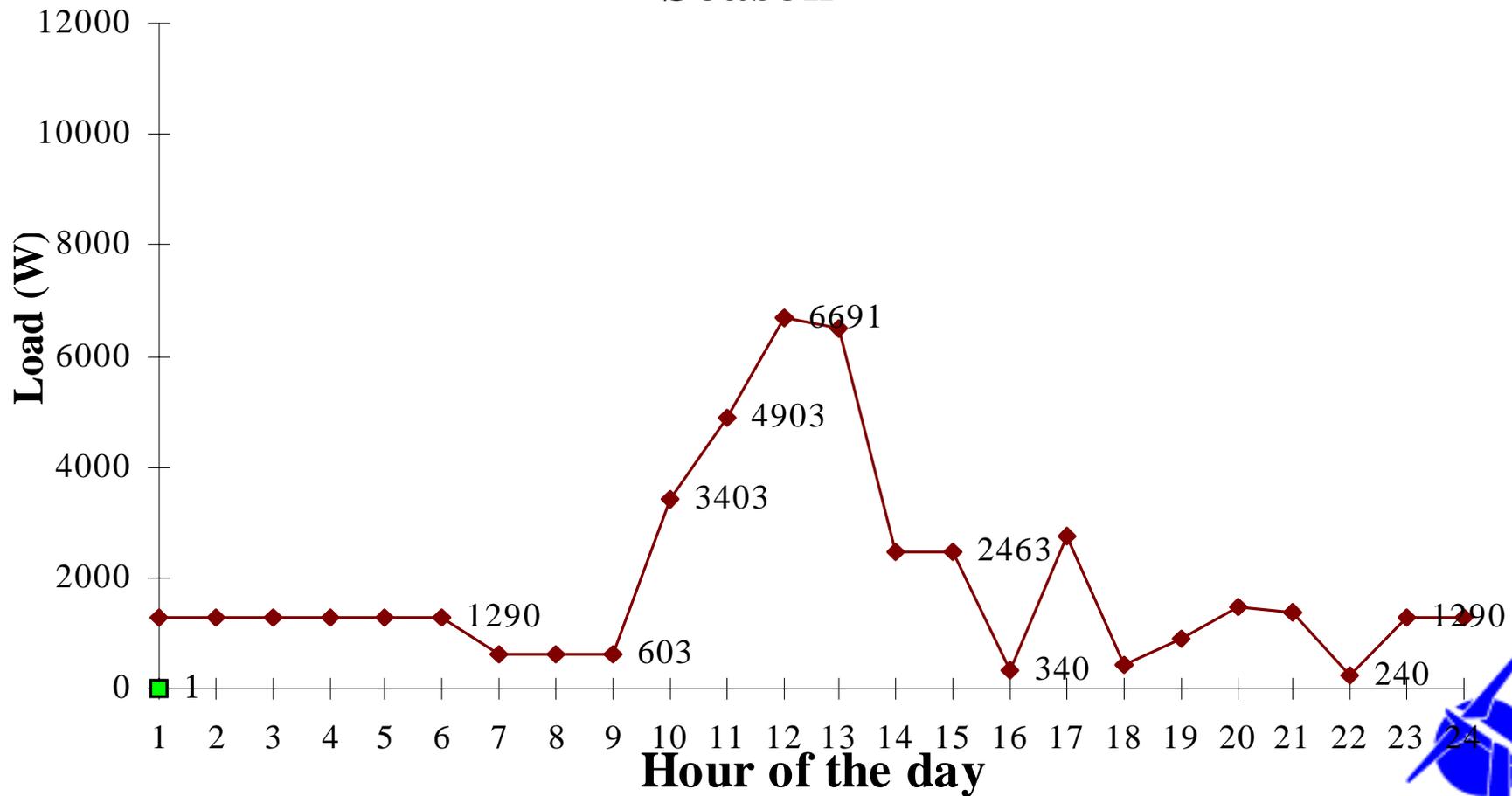
Why Ecotourism hotels for wind-hybrids?

- Ability to pay for system because of cash flow from business
- Owner frustration with existing diesel system
- “Green marketing” concept appeals to owners and customers
- **Smaller ecotourism hybrids are less complicated compared to larger village hybrids....Serve as ideal path for technology commercialization**
 - Mini-grid for resort is small and manageable
 - Resort owners typically have good technical for O&M
 - Energy conservation and load management easier to implement (lighting changed to CFs)
 - Metering, billing and sharing of energy not an issue



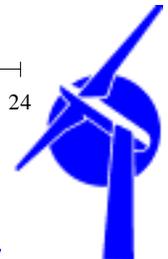
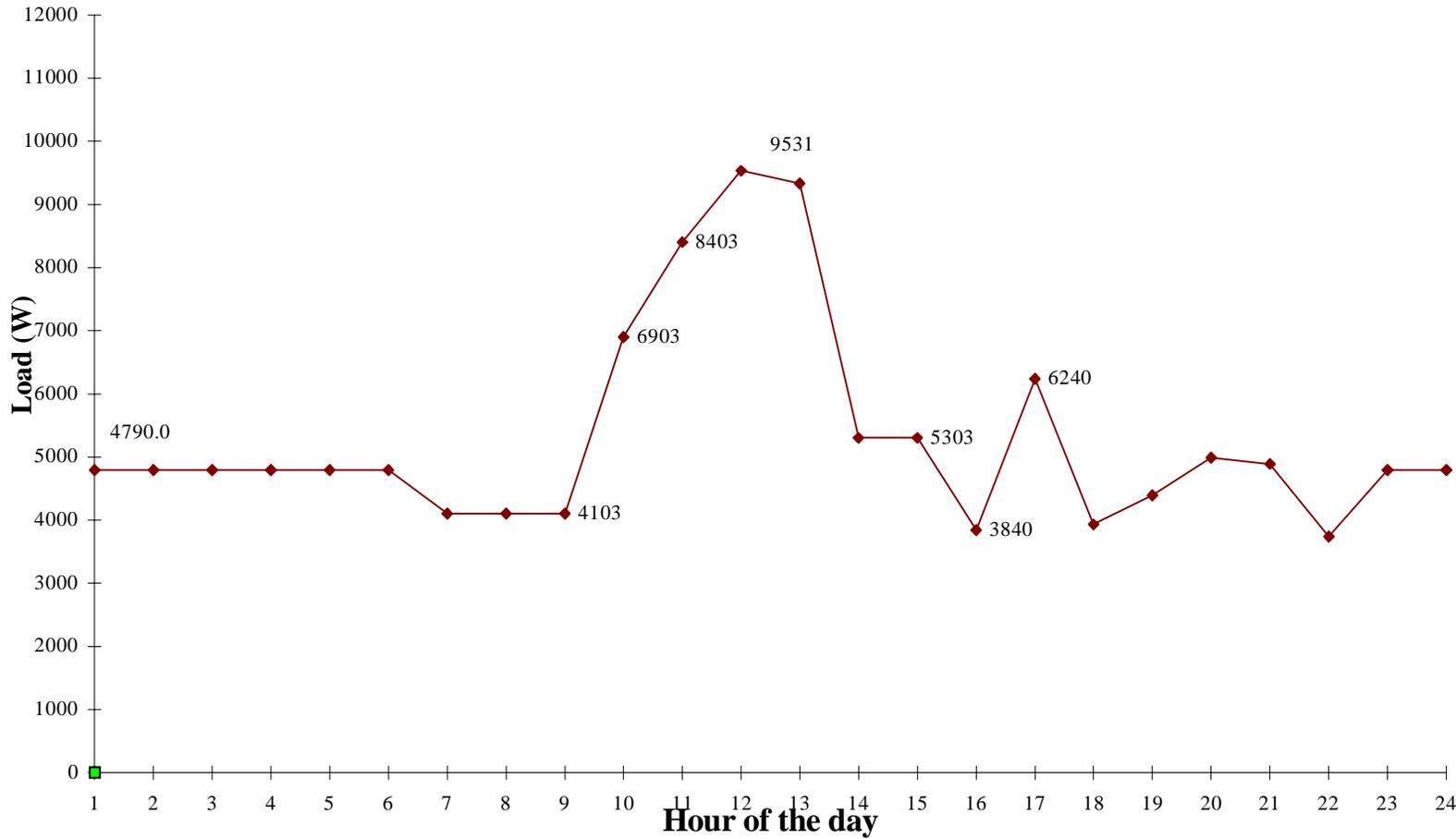


Daily Load Profile - 46 kWh/day - No RO Peak Season





Daily Load Profile - 127.4 kWh/day - With RO at Peak Season





Equipment Description

- Bergey EXCEL turbine - 48-volt winding (no transformer); 10 kW output connected to grid, about 7 kW output for this battery charging application (funding only available for 1 turbine)
- New turbine corrosion package addresses problems experienced by nearby Xcalak turbines
 - Stainless steel hardware used throughout including pitch weights; Guy wires use corrosion resistant coating; stator epoxy encapsulated
- Lattice type tilt-up tower
- Two “stacked” 5.5 kW TRACE inverters for both 120 and 240 volt loads (to power RO system) at 11.0 kW total rated capacity
- Three parallel strings of Trojan L-16 batteries (nominal 1050 amp-hours at 48 volts = about 50 kWhs storage)





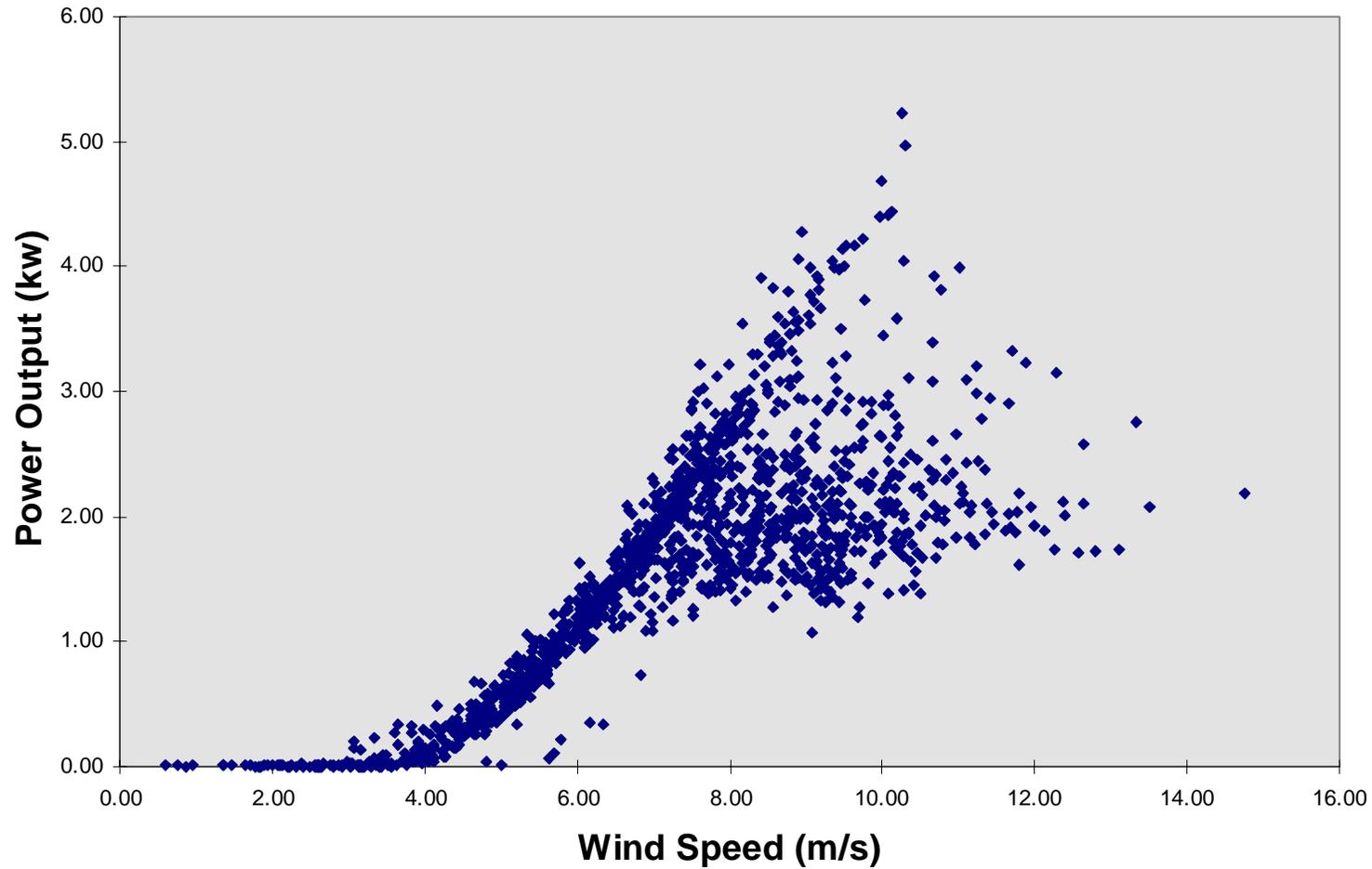
Diesel Operation

- Wind system *not* designed to run the reverse osmosis system for long time periods; diesel would run the system during high water loads
- System originally designed as switched system where either 3-phase diesel or 2-single phase inverters meeting the load but not both at same time - However, owner bought large RO system that inverter couldn't start
 - Inverter surge capability cannot start oversized RO system so diesel was rewound to two phase and parallel capability between inverter and diesel used



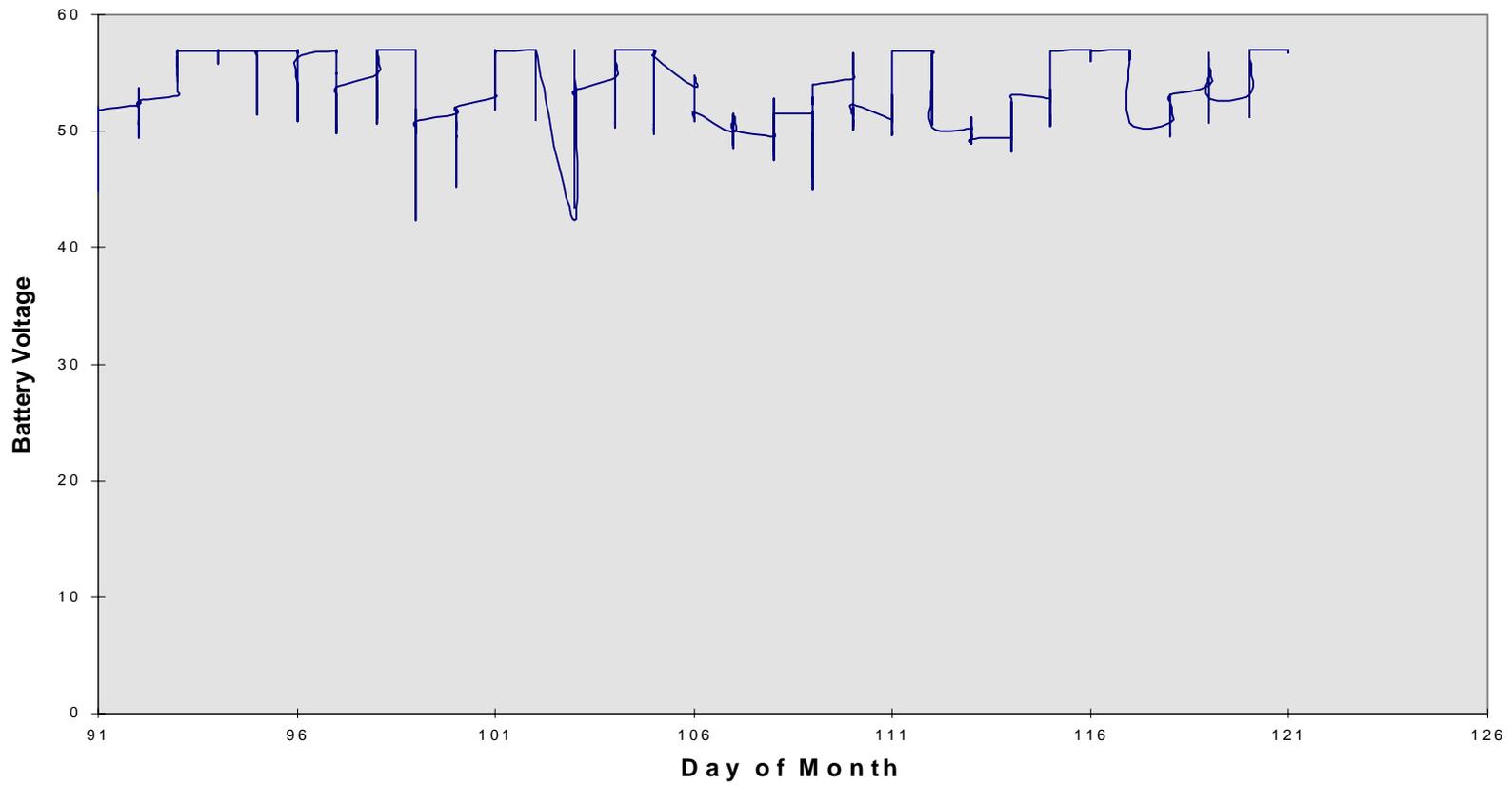


Turbine power versus wind speed - all voltages



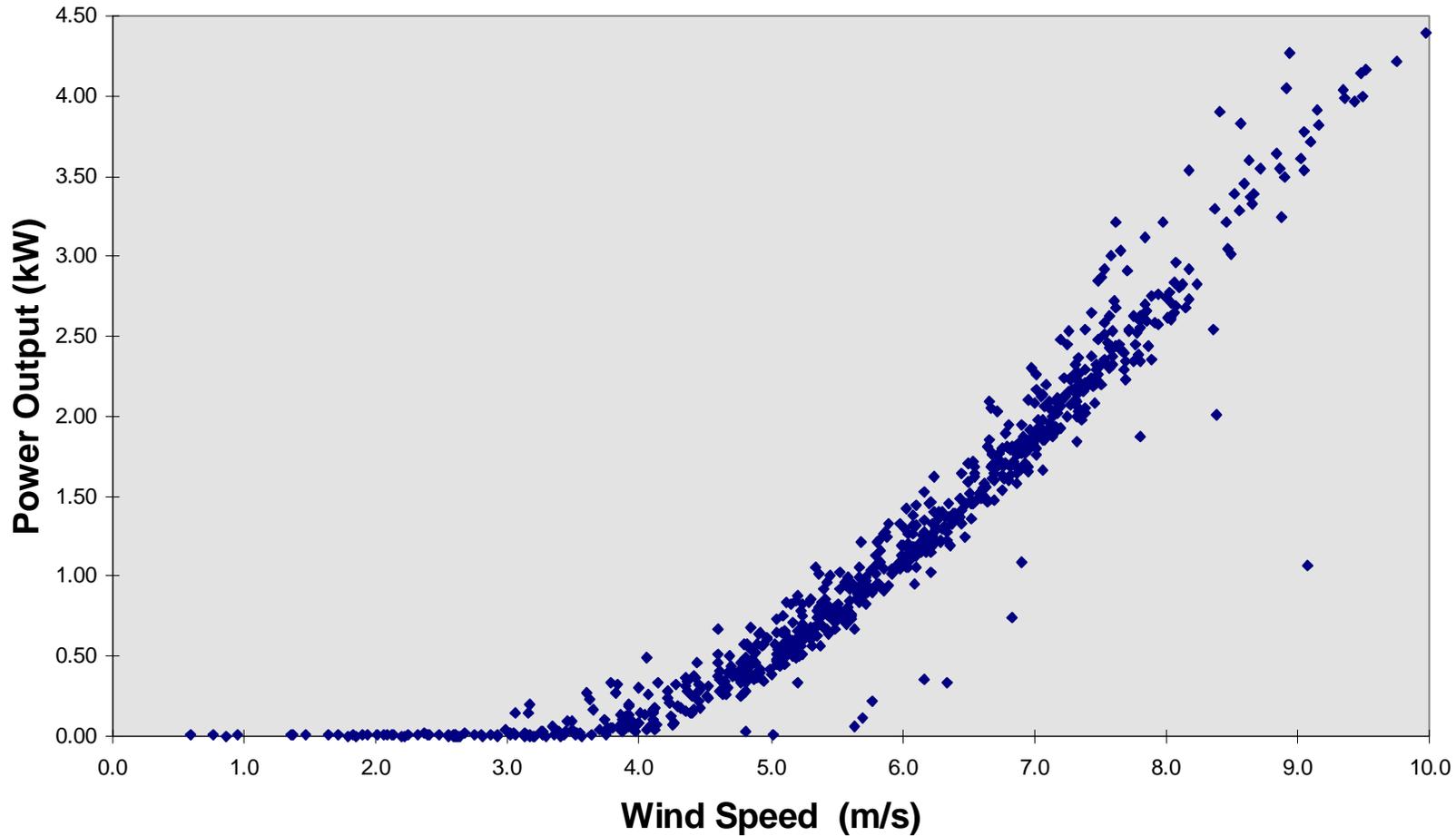


Battery Voltage for May



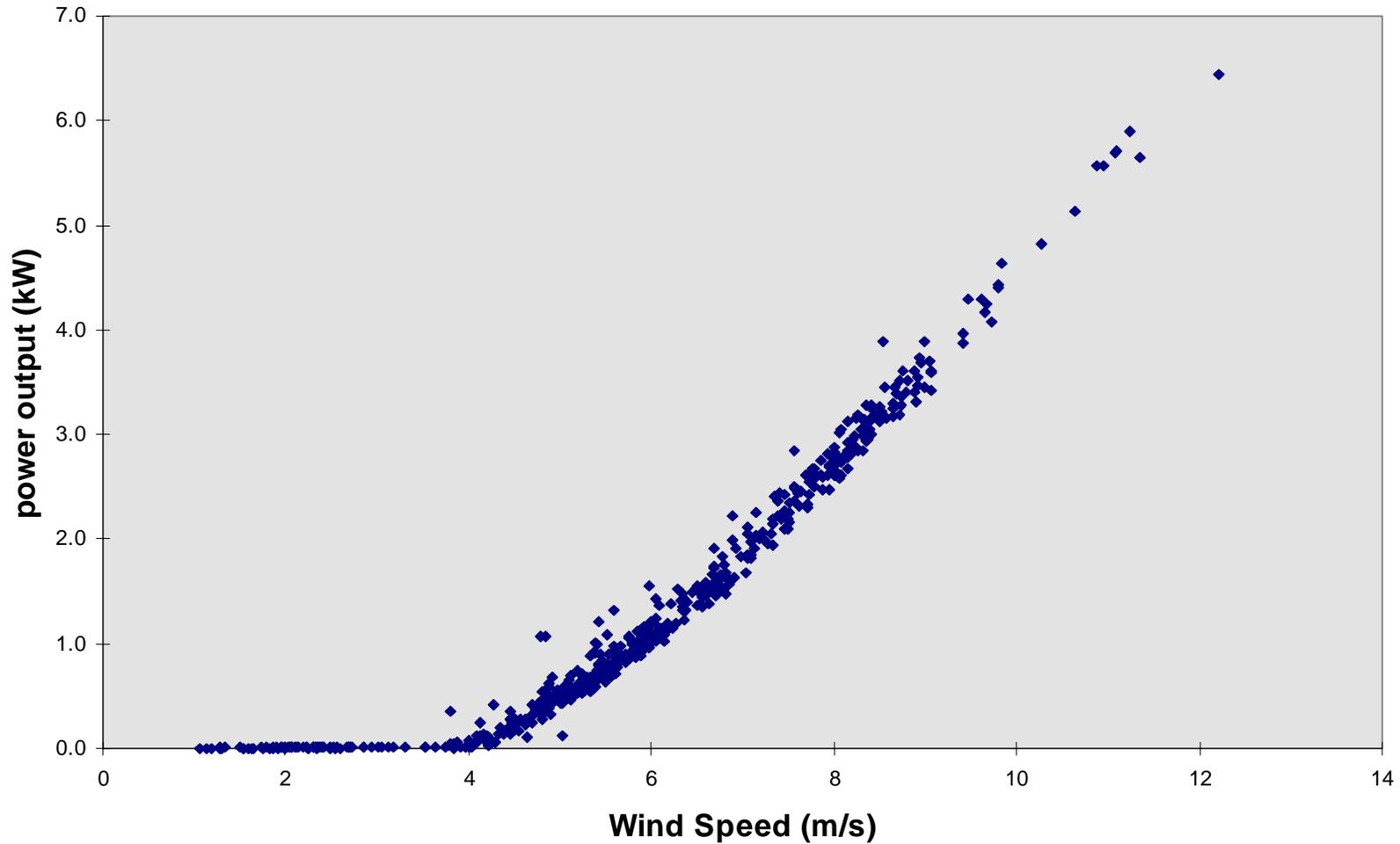


Turbine power vs. wind speed for voltages < 54 volts





Turbine Output versus Wind Speed (1 second average)





Summary of Monitoring Results and Lessons Learned

- Noise can be an issue
- Existing diesels can be maintenance nightmare - Usually better to buy new diesel
- Design of 2 phase RO load with three phase existing diesel system important
- Training for RO system important
- Load management important
- Turbine corrosion packages available and should be used for all salt-spray environments - Long term monitoring of wind machines in these environments important
- Low loads have resulted in low wind turbine output and low battery efficiency

